NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
400 MARYLAND AVENUE, SW, WASHINGTON 25, D.C.
TELEPHONES: WORTH 2-4155——WORTH 3-1110

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Bio

Address by
James E. Webb, Administrator
National Aeronautics and Space Administration

DUKE UNIVERSITY SYMPOSIUM
on the
Regional Implications of Space Research
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The one thing about which we can be sure as the Space Age unfolds is that man will benefit greatly from this vast new medium that he has entered. Precisely what we will gain can be defined no more completely now than could be envisioned at a similar early stage the dividends from the early steam engine, the discovery of oil, the Wright Brothers' demonstration that men could fly through the atmosphere, or the ultimate benefits accruing from the release of nuclear energy.

All these things have altered, and are altering, the patterns of civilization on our planet. The same applied to the broad and accelerated program we have undertaken for exploring space near the earth and out to vast distances from the earth, and for assessing and measuring the forces, particles, and chemistry of nature.

The subsidiary benefits of the national space program will be increasingly felt in many areas of our technical-industrial complex. More and more, thoughtful people are regarding space for what it truly is, a rich resource -- just as land, rivers, seas, the atmosphere, and knowledge, skill, and brainpower are great resources. The exploration of the limitless resource of space is an objective so tremendous and meaningful to both civilian and military agencies that nothing short of effort on a national scale could do it justice.

Some of the most significant and important events of the present century -- certainly of this decade -- will take place in space or will stem from space endeavors. They will affect our lives, education and the professions, our industries, our economy, our international standing, and our national security in many ways which we cannot foresee at present.

The National Aeronautics and Space Administration is a research and development agency. We are concerned with providing the organizational framework and the tools that will make it possible for this Nation to take part fully in the great adventure involved in learning about and making use of space.

A primary requirement of space activity is rocket power. Launch vehicles constitute the most expensive portion of the space program and require the longest time to produce. We must have rockets of different sizes and power to carry out projects of varying degrees of difficulty. Until now, NASA has been relying on several rocket vehicles developed for near-earth military purposes, to launch relatively small satellites and probes for scientific research, technological development, and the first phases of manned space flight.

Just coming into use are more powerful, versatile vehicles which make it possible to land instruments on the moon and to investigate regions near Venus. In years to come, we shall have still more powerful rockets for even more ambitious projects.

A National Launch Vehicle Program has been worked out by the Department of Defense and NASA that includes 10 different rockets of graduated sizes and power, from which we can choose the vehicle best suited to each mission. All the vehicles are available to any agency of the Government having missions in space. There is not time tonight to describe all these vehicles, but I do want to give you a feeling for what is involved.

The five smallest vehicles, already in use, range from the Scout, which can lift 150 pounds into orbit about the earth, to the Atlas-Agena B, which can lift 5,000 pounds into earth orbit and which last month furnished the power to drive the 730-pound Ranger 4 outward 240,000 miles to the first landing of an American-made object on the moon.

In the next few years, we shall have still more powerful vehicles, such as the Titan II, which will provide the power for launching our two-man Gemini spacecraft into earth orbit, and the Centaur, which will make it possible to send more than half a ton of instruments to Mars.

Going up the scale, we are developing the Saturn, which has had two highly successful flight tests of the first stage, the most powerful rocket vehicle, so far as the world knows, launched into space to date. The second stage of the Saturn, which we plan to test-launch next year will use liquid hydrogen fuel and thus will benefit from pioneering research in the Centaur program. This new fuel must be maintained at a temperature of 423° below zero Fahrenheit and represents a most difficult technology to master.

In its first two flights, the Saturn first stage generated thrust of a million 300,000 pounds, roughly equivalent to the combined power of 100,000 modern automobiles running with the accelerator pedal on the floor. This model of the Saturn will have thrust enough to boost a 10-ton version of the three-man Apollo spacecraft into orbit about the earth to gain extended experience with weightlessness and for operational and training flights in preparation for manned flights to the moon.

The mightiest booster now under development is the Advanced Saturn, a completely new launch vehicle with a five-engine first stage, each engine as powerful as all eight engines of the present Saturn. When the Advanced Saturn is ready for operation four or five years from now, it will be able to lift 100 tons into orbit about the earth, and speed more than 40 tons to the vicinity of the moon.

Advanced Saturn will generate power for a flight around the moon but only about half enough to launch the Apollo spacecraft fully loaded and equipped for a landing on the moon and return to the earth.

The last vehicle on our current developmental list is a giant among giants, Nova, which will produce enough thrust to launch the Apollo spacecraft directly toward a landing on the moon. A thorough analysis of Nova requirements is now in progress. As presently envisioned, the Nova would enable us to lift about 200 tons into earth orbit or speed 75 tons to the neighborhood of the moon.

The Nova will be a general-purpose vehicle. It will provide an efficient means of transporting large payloads to the moon and out into space for the period beyond the first landings. It will also make it possible to launch very large manned stations into orbit about the earth, to carry out any task the national interest might require. If Congress appropriates the funds requested by President Kennedy, we plan to begin development of the Nova for manned flights within five years of that time.

Because of the long time required for Nova development, we are investigating means of carrying out the landing on the moon with the Advanced Saturn, which will be available sooner. If we can perfect the technique of rendezvous and joining two objects together in orbit about the earth, for example, we might be able to achieve the lunar landing as much as two years sooner than with the Nova direct ascent approach.

Another possibility is application of nuclear energy to rocket propulsion. If a workable rocket engine can be developed, it may be possible to make the landing on the moon, using an Advanced Saturn with a nuclear upper stage.

In any case, we are pressing forward with nuclear rockets for the promise they hold for solving space propulsion problems of the next decade. The ultimate rocket we can now foresee is Nova with a nuclear-powered upper stage.

While rockets are the engines we use to send instruments and men into space, the spacecraft which ride on the rockets enable us to accomplish useful work when we get there.

We have a versatile array of spacecraft under development to use with our family of launch vehicles. They are in four categories:

1. Orbiting Observatories and other unmanned spacecraft which will explore the earth, moon, Mars, and Venus.

2. Manned spacecraft, Mercury, Gemini, and Apollo, which will take our astronauts on longer and longer journeys through space, culminating in the lunar landing and return to earth in this decade.

3. Experimental communications satellites.

4. Experimental weather satellites.

Our large unmanned Orbiting Observatories are second generation spacecraft. They are new scientific satellites, carrying a large number of instruments, which circle the earth beyond the atmospheric veil that obscures much of the view of earth-based observatories.

The first of these, the Orbiting Solar Observatory, has been aloft since March 7, and has been performing magnificently.

By 1964 we plan to have four types of observatories working in space at all times. Included will be the Orbiting Astronomical Observatory and the Orbiting Geophysical Observatory. We expect the new knowledge of the universe gained from these Orbiting Observatories to form the base for a large number of major scientific achievements.

Rounding out the program will be the use of many sounding rockets and a few deep space probes.

The Ranger spacecraft made the first landing on the far side of the moon last month, but failure of a timing device kept us from getting the television pictures we expected. Another Ranger shot will be made later this year and several more next year.

In 1964 and 1965, we plan to make nine flights to the moon with a more advanced spacecraft called Surveyor. Some of these nine Surveyors will orbit the moon and take detailed pictures of its entire surface. Others will make a soft landing with two to three hundred pounds of instruments, including television cameras and a drill for sampling down to a depth of three feet.

Planetary exploration will continue this summer when two Mariner spacecraft will be launched toward Venus in late July or August. Our flight plans call for these to come within

25,000 miles or closer to Venus as they fly by on their way to become satellites of the sun.

In 1964 we plan to send improved versions of the Mariner spacecraft to Mars and Venus, using the Centaur rocket.

With the increased power of the Saturn rocket by the middle of the decade, we plan to launch a larger spacecraft called Voyager, which will go into orbit around Mars or Venus and send an instrumented capsule in for a landing.

In the area of communications satellites, four different experiments are scheduled for launch by NASA within the next six to nine months -- Relay, Telstar, Syncom, and Echo II. The first three will serve as relay stations, and thus will have receivers and transmitters on board. Echo II -- a balloon 135 feet in diameter -- will be a passive satellite to reflect radio waves.

The last of our family of spacecraft is in meteorology. The fourth TIROS weather satellite is now in orbit, taking pictures of the earth's cloud cover and measuring the heat reflected by the earth into space. Early next year, we expect to launch the more advanced weather satellite Nimbus, which will be in orbit over the poles about 500 miles high.

The instruments in TIROS are able to point toward the earth only half of the time, but in Nimbus they will point continuously toward the earth. Furthermore, since it is in polar orbit, Nimbus will be able to cover the entire globe. A still more advanced weather satellite under development is Aeros, which will be launched beginning in the mid-60's into orbits that will enable us to keep constant watch on hurricanes and other developing storm systems.

What I have outlined about our launch vehicles and families of spacecraft -- and time is lacking to present more than an outline -- should give an indication of the scope and variety of our national space program.

We are gaining pioneering experience in flying in space. We have proved man's ability to function effectively as pilot, engineer, and scientific observer in space, and to out-perform the most advanced instruments in some situations.

We still have to test man's adjustment to zero gravity over periods of a full day or a week.

In our strictly scientific research, we are providing means to answer basic questions about the universe which can be only remotely investigated with the largest telescopes or the most elaborate instruments on earth.

We are pressing forward in many frontier areas of science and technology -- such as electronics, metallurgy, propulsion, and the creation of controlled environments.

Vast and complex resources and facilities are required to support our expanding space activities of this decade and this generation. To the launch vehicles that must be built, and the spacecraft which must be supplied with instruments, we must add the launch facilities, worldwide networks of radio and radar stations for tracking and receiving information, and the many machines and highly perceptive human beings who must read and interpret the electronic messages which come back in such great volume from our manned and unmanned spacecraft.

It is clear that the exploration of space calls for major national attention and effort requiring vision, careful allocation and management of resources, and cooperation among industry, Government, the universities and the scientific community, not only to meet the goals of today, but to create the additional resources of trained intelligence and skills that our accelerated space program requires.

The country's greatest achievement in the space program has been the creation of a truly national effort -- as dynamic as it is urgent -- for mobilizing large resources of scientific knowledge and advanced technology to achieve clearly defined national goals. The significant fact of this decade will be more than the landing of a team of United States explorers on the moon. It will be the demonstration of the will and ability of our Nation to organize and carry out the great effort that makes such a landing possible.

What does all this mean for education?

During the first four decades of this century, research and development constituted a minor part of the stream of our national activity. During World War II, science was married to the military effort and a vast expansion of research took place. Such new things as radar and the atomic bomb required tremendous mental and physical exertion, and this introduced a new element to science, the requirement for large-scale, organized effort. Invention became the work of organized teams and vast laboratories. Since the war, from this marriage has been born a giant.

In the 12 years from 1946 to 1958, more than 50 billion dollars were spent in this country for scientific research and development by the Government, by universities, and by industry. In the four years since 1958, the years of the Space Age, more than 52 billion dollars have been spent in the Nation for research and development. At the beginning of the Space Age, in 1958, the annual level of national expenditures to acquire new scientific knowledge and to apply the knowledge that had already been accumulated amounted to between six and seven billion dollars.

Today this level has almost tripled to a level of 16 to 18 billion dollars. We have reached a point where, almost without exception, everything to which the individual must adjust himself is big, or new, or fast-moving. We have the giant corporation, mass production, mass marketing, mass communication, big government, jet transportation, new materials, and scientific management of it all.

With the advent of the rocket, the new engine which has the capacity to deliver its power both within the earth's atmosphere and out beyond the earth's atmosphere, the speed of the process of change will increase again. It is the rocket which makes it possible for man to propel himself into space, to conquer the new environment of the universe, to do useful work in this new environment, and to bring back new knowledge about the forces of nature and about the way nature is organized. And we know that much that is learned can be applied here on earth to accomplish vast improvements for the benefit of all mankind.

The rocket, this new and powerful engine, not only permits these useful activities but also provides the means for the delivery of weapons of mass destruction, almost instantaneously, anywhere in the world. Its availability, its versatility, the vast potentials which stem from the technologies associated with it, require that this Nation not expose its very existence to the risks of a second-best position in space science and technology.

Fortunately, the tremendous benefits to be gained from the vigorous and active prosecution of our space program, which is now going forward under the leadership of President Kennedy, recognizes not only the national security necessities but also the widespread economic, medical, and educational opportunities which are inherent in these new and powerful forces.

The success of our space program is dependent upon rapid advances in efficient use of energy; the development of new materials, metals, fabrics, and lubricants which can withstand wide ranges of temperature, vibration, radiation, and vacuum; the most advanced electronics; and the marriage of all of these with the life sciences.

All of these are the very forces underlying economic growth.

But there is a new situation, so new it is little understood, related to the developments of the past decade. Today, the inventions and innovations which make the best use of the advances in these new areas can come only from an intellect which has acquired a sophisiticated, complete understanding of the basic laws of nature as they have unfolded at such a rapid rate.

In my view, our national heritage of the frontier spirit provides today the dimensions within which the problems of the new frontier of change can best be pioneered and answers found. The new frontiers of knowledge in the physical sciences have laid a foundation for the same type of rapid advances in the life sciences. Just ahead is an understanding of the life processes, just as we now understand atomic processes.

The full development of the possibilities inherent in the application of scientific and technical advances can usher in a period of economic growth that will bring a flowering of education and culture. Because the application of knowledge must be more sophisticated than it has been, the university, which must do research and prepare the graduate and postgraduate trained minds for this new period, must somehow find a closer relationship with the business community. The entrepreneurial mind is in our society the means for the application of these benefits. Innovation in these new industrial-university relationships can be pioneered if the leaders of the community desire to apply foresight and participate in the development of widely shared goals.

Many of our Nation's largest programs in research and development have either been of a defense or atomic nature, and therefore classified for national security reasons.

Much of our space program, under the National Aeronautics and Space Act of 1958, is unclassified. NASA is required to consult with the scientific community in the design of its program and experiments, and to report not only to the scientific community, but also to the general public on the agency's activities and the results thereof. Further, the fullest measure of cooperation with other nations is specified in this basic act of Congress that established the space policy of the Nation.

Under these circumstances, NASA is not building up large classified Government laboratories but is contracting as much as possible of its advanced research and development to universities. Our policy is to give research contracts and grants to those universities where the scientists themselves, the faculty, and the administration of the university are interested in having the work progress on an interdisciplinary basis, drawing together creative minds, knowledge, and resources from fields such as mathematics, physics, astronomy, chemistry, and medicine for widely shared participation. Under this policy, NASA research proceeds in the closest association with graduate and postgraduate education, thereby replenishing and augmenting the supply of highly qualified scientists, engineers, and technical experts.

It is an important fact to education, to industry, and indeed, to all persons and groups interested in economic, social, and political growth, that the technical fields in which most of our work is done embody the very forces with which regional and community leadership are concerned. These are the forces with which regional leadership must work for progress, improvement, and greater efficiency.

It is also true that the institutions through which citizens and regional and community organizations cooperate to utilize these forces are not as yet strong and reliable. The policies underlying NASA's contracts and grants with universities and its contracts with industry make for a widespread understanding and capability for application beyond the scope of the science and technology involved in our programs.

These policies also create a situation within which the interdisciplinary groups working in the universities, if joined with other forces for progress and growth in the community, can lay the base for even more rapid assimilation and use.

NASA is taking steps to help deal with the shortage of graduates in science and engineering. The commodity in most critically short supply is highly trained brainpower. We have just recently announced support of a training program at 10 universities, beginning next fall, to increase the supply of scientists and engineers who can contribute to the national space effort.

In the first year of the new program, each of the first 10 universities selected will train 10 students working toward doctorates. Students chosen will receive stipends of $2,400 a year for 12 months' study, and expense allowances of up to $1,000 a year. The universities will be reimbursed for tuition, fees, and other expenses involved.

Let me re-emphasize the importance of the space program to education -- and particularly to graduate education in science and engineering -- in keeping our country abreast of the new age of science and technology. Research-and-development is the key to almost everything we do in space at this early stage.

Today, large industries tend to concentrate in regions where research facilities are best. No part of the country can afford to neglect investments in advanced scientific and engineering education and in first-class research facilities.

People in different sections of the country are naturally interested in seeing how their own areas can participate in the national space program, how they can contribute to it, and how they can benefit from it.

The Duke Symposium is an expression of this interest. We shall follow the results of meetings such as this with great interest.

I believe the regional approach is sound. It permits a number of universities to pool resources for research and to plan complementary programs directed to the needs of the region.

Industry, too, has much to gain from regional cooperation in support of the universities and associated research efforts. Industrial leaders are beginning, more and more, to look to the universities of their region for the most important resource of the age -- ideas, scientific brainpower, and advanced technological skill and experience.

It is not a question today of whether a region can already qualify -- can now offer the human and natural resources required -- for a particular industrial plant or government facility.

The question is whether the region is creatively doing what it can to equip its citizens to serve their area and their Nation in a period when our prosperity and our very existence as a free people depend on scientific and technological leadership.

Space research and development is already producing corollary benefits in the form of new products, new methods, and new materials which can be employed in the manufacture of countless articles for human use. Yet we have scarcely scratched the surface as far as these benefits are concerned.

Recently, we have undertaken an experimental program in this field, which is being conducted in six Midwestern states. A NASA contractor, Midwest Research Institute, is examining the work in NASA centers in an effort to find practical applications of space science and technology, and working with private industries to find ways through which these can be utilized generally.

Midwest Research Institute has completed a preliminary survey of NASA research centers and installations and has compiled a list of 51 inventions, or new processes, originating in the space program which have been, or might be, put to work in other areas of our economy.

Here are several examples worked out by NASA research centers:

... A laminated material of Mylar film and parachute nylon which is used for the inflatable life raft carried on the Mercury capsule. This extremely lightweight material might be used for commercial life rafts, tents, air mattresses, and so forth.

... For welding fuel tanks of the Saturn rocket, an eddy-current device has been developed that guides the head of an automatic welding machine accurately along the seam between two pieces of metal, even if the seam is not straight.

... A long-life, anti-friction, non-lubricated bearing has been made of plastic, impregnated with metal. These bearings are being used successfully in the Orbiting Solar Observatory under conditions which would quickly burn out oil-lubricated bearings.

... Energy-dissipating, fragmenting metal tubes have been developed to take up the shock when the Apollo spacecraft lands. It has been suggested that similar systems might replace coiled springs at the bottom of elevator shafts or might be built into automobile bumpers to reduce the shock of high-speed collisions.

... A camera has been developed for taking rapid-sequence, high quality pictures of wind tunnel experiments and is now being used by sports photographers and by industrial designers for motion studies and for analysis of structure failures.

... Printed electrical conductors imbedded in a flexible insulator like Mylar or nylon, which can be cemented to any structure, have been developed. One of the 1962 automobiles (Buick) uses this flexible printed cable to replace the conventional dashboard wiring harness, and there are many other possible uses for mass-produced items.

... In the survival pack of the Mercury capsule are a life raft with water ballast attachments which keep it from tipping even when a man stands on one edge; an inflatable radar reflector which can be spotted by a searching airplane 50 miles away; and an emergency life vest that stows in a compact, light package yet can be inflated and put on in 10 seconds by a man in the water wearing a space suit. Overseas airline and surface vessel uses of these devices are predicted, as well as employment in a variety of commercial products.

These are just a sample of the many and varied possibilities for using space technology which are beginning to appear. Mr. Louis Fong, representative of the NASA Office of Applications, who will speak at your session tomorrow morning, will have further information on this subject.

President Hart, may I congratulate you and all those who have worked with you on the organization of this symposium. I am convinced that your endeavors to help prepare the southeast region -- along with the Nation -- to meet Space Age scientific and technological problems will help bring opportunities for the young men and women, the universities, and the industries of this region.

This and similar work in other regions of the country have particular significance now that, in real earnest, the United States has determined to overcome our early lag in some aspects of space exploration.

As President Kennedy has phrased it, "This is the new ocean, and I believe the United States must sail on it, and be in a position second to none."

Thank you very much.

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